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compts.

THE

SOULANGES CANAL

BY

THOMAS MONRO, M. Can. Soc. C.E.

M. P.

after 1896

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At the close of 1888 the writer was transferred from the Welland Canal, and assigned the duty of determining the best location for a canal, having a navigable depth of fourteen feet, between Lakes St. Louis and St. Francis.

After extensive surveys and examinations, he submitted a report, dated 15th June, 1889, addressed to the late John Page, M. Can. Soc. C. E., Chief Engineer of Canals, in which reasons were given why the new canal should be constructed on the north side of the St. Lawrence. Mr. Page died in 1890, and in June of that year a second report was addressed to the Secretary of the Department, confirming the views previously expressed. In that document the projected work was for the first time named the "Soulanges Canal."

In a memorandum dated 25th January, 1891, prepared for the Right Hon. Sir John Macdonald, by Toussaint Trudeau, M. Can. Soc. C. E., Deputy-Minister and Chief Engineer of Canals, the scheme submitted by the writer was approved of in general terms. This view was subsequently confirmed by the Government, and, in August, 1891, a sum of $300,000 was voted by Parliament towards the construction of the Soulanges Canal, which was then estimated to cost $4,750,000.

Plans and specifications of the work were subsequently prepared; and in May, 1893, all the thirteen sections between Cascades Point and Coteau Landing were under contract.

It is not intended to discuss in this paper the fitness or otherwise of the dimensions adopted for the Welland and St. Lawrence Canals. The writer's views on this important subject are fully set forth in his address on retiring from the office of President of this Society on the 15th January, 1896. The object now proposed is to briefly describe the Soulanges Canal as it is, and to draw attention to the fact that in many essential features it differs in design from the other links of the St. Lawrence system.

It may be stated, at the outset, that more extended study of the question of the fluctuations of the St. Lawrence River led to the con-

clusion that it would be unsafe to accept previous records as a guide in fixing the heights of the mitre sills at each end of the canal. The lowest water at Valleyfield (1849-90) was in October, 1872; when it fell for part of one day to 10′ 8″ on the mitre sill of the guard lock at the head of the Beauharnois Canal. But the mean for that month was 11′.3″. Practically, 11 feet would therefore represent extreme low water during the navigation season. Adopting this view, the sills of the guard lock at the head of the Soulanges Canal should have been placed 3½ feet lower to secure a fourteen feet draught. As a matter of fact, the sills of the Soulanges are *five feet* lower than those at Valleyfield; and it is due to this that, in November, 1895, when the lowest water occurred of which there is any reliable record, there was a depth of 14.55 feet at the upper entrance, and 14.83 at the lower end of the Soulanges Canal. In the same month there was only 13.50 feet at the lower entrance of the Cornwall Canal, and 13.08 at the head of the Lachine Canal.

Attention is drawn to these facts, because between the time when the estimate attached to the writer's report of June 18, 1890, was made, and the letting of the works, the bottom plane of the summit level (10½ miles long) and the foundations of the structures on it, were lowered about 1½ feet, largely increasing the quantities, and adding, at a fair valuation, about $500,000 to the estimated cost of construction, which, instead of $4,750,000, should be placed at $5,250,000.

It may also be stated that in previous canal surveys along the St. Lawrence, various datums were employed, making the results somewhat confusing, or only intelligible after a good deal of trouble. An attempt has been made to avoid this by referring the levels of the Soulanges Canal to mean tide at New York. To do this, lines were run from a bench mark established by the U. S. Coast and Geodetic Survey at Rouse's Point, N. Y., to the head of the Beauharnois Canal. In this way the mean level of Lake St. Francis was found to be 154.80; and directly connected with the records at the Valleyfield lock since 1849. The U. S. Army Engineers have determined the mean height of Lake Ontario (1860-75) at 246.61 above the same datum, so that the difference between Lakes St. Francis and Ontario should be (to close the circuit) say 91.81 feet. Lines run under the writer's direction between Coteau Landing and Kingston confirmed these figures. But the previously accepted distribution of fall was found to

be quite erroneous. The descent from Kingston to Prescott was supposed to be three or four feet. It is now approximated at about one-third of a foot, pending the completion of the precision levels begun some years ago under the able direction of Mr. René Steckel, M. Can. Soc. C. E., of the Public Works Department. This work has not yet been continued along the St. Lawrence above Lachine. It may be stated, however, that levels recently taken by the Engineers of the U. S. Deep Waterways' Commission only differ 0.12 from the figures given above as representing the relative levels at Rouse's Point and Valleyfield—about 47½ miles apart.

Attention is drawn to the accompanying lithographic profile of the St. Lawrence, prepared for the Canadian Deep Waterways' Commission of 1895, as explanatory of the foregoing remarks. This profile shows the position and length of the various canals between Kingston and Montreal. The fall in the river is about 220 feet. That overcome by locks is about 204 feet.

It will be seen that Lake St. Francis is 33 miles long. It is merely an expansion of the river—a pool above the rapids between it and Lake St. Louis. The fall between these lakes is 82½ feet at mean water. In this distance of about sixteen miles there are the Coteau, Cedars, Split Rock and Cascades Rapids. At some points on the river there is a depth of not more than six feet in the channel at extreme low water. It is to surmount these rapids that the Soulanges Canal has been constructed. Its position is shown on the small sketch map which accompanies this paper.

The canal is 14 miles long, and leaves the foot of Lake St. Francis at Macdonald's Point, just below the village of Coteau Landing. Thence it runs straight 1½ miles, touching the margin of the river about a mile from the upper entrance. From the end of this tangent the line sweeps round to the north-east behind the village of Coteau du Lac for about three miles on a curve of 14,324 radius. It is then continued by a second tangent of some 8½ miles long, passing about a mile inland from the Cedar's Village. At the termination of this, the line bends slightly to the north, and is led straight into the Ottawa River, about two miles from its junction with the St. Lawrence at Cascades Point. The canal is, for all practical purposes of navigation, a straight line throughout, and is two miles shorter than the route by the river.

The fall of 82½ feet is overcome by four locks:— 70.50 feet of this is

at the Cascades end, where the bluff forming the right bank of the Vaudreuil branch of the Ottawa gives an opportunity of locating three of these in the first mile; each having a rise of 23½ feet. The original design was for five locks. This was subsequently made four, and, after extended examination, the writer, on January, 1895, proposed a further reduction to three. In this view he was sustained by Messrs. Shanly and Keefer, who were retained by the Government to advise in the matter. The height of these lifts constitutes a peculiar feature in the Soulanges Canal.

There is an interval of over two miles between the third and fourth locks. The latter is about 3 miles from the lower entrance. Here the lift is variable. It is about 12½ feet at mean water of Lake St. Francis —but at extreme high periods it would (if this water were permitted to enter the canal) be about 15 feet.

At the upper entrance there is a guard lock by which the surface level of the summit can be regulated without interruption or danger to navigation. At periods of high water, this will be used as a lift lock, but, at ordinary stages of the lake, its surface level will be that of the canal. It is needless to point out to this audience the necessity of this arrangement. Canal Engineers of experience will admit that such a safeguard is indispensable.

About 1,000 feet above Lock No. 4 there are a pair of guard gates placed for safety to the lower locks in case of accident.

The distribution of lockage as above described is supplemented by a series of weirs for the passage of the necessary supply. That at the head of the canal has four openings 9′ x 10′ furnished with gates of the "Stoney" pattern. The tops of these gates will be submerged when hoisted. This structure is connected with a raceway of large dimensions formed to the south of and parallel to the guard lock. This channel is about 650 feet long, and is pitched on both sides. It passes into the canal through a series of masonry arches, and will amply fulfil the intended purpose without creating objectionable currents. About five miles from the upper entrance, at the crossing of the River à la Graisse, a large weir has been constructed having six arched openings 6′ x 6′. It will regulate the summit level of the canal, which can be either lowered or entirely emptied at this point. The channel from the weir connects directly with the River à la Graisse a short distance from its junction with the St. Lawrence. In

connection with this weir, a power-house is being erected which will be alluded to further on.

The supply is passed by the guard gates above lock No. 4 through two 20′ x 22′ Stoney sluices; and at locks 4, 3, 2 and 1 the regulating weirs consist of twin culverts through the dividing embankments between the various reaches, having submerged gates controlled from the top bank level through shafts of concrete and masonry.

It will be observed that the water for supply is not in any case passed over breast walls, the writer's experience being that such an arrangement is objectionable in this climate.

There are seven road bridges and one railway bridge across the canal. The latter traverses the lower wings of the guard lock, and carries the Canada Atlantic Railway. It swings over the lock and raceway, and is about 180 feet long. The superstructure of this bridge was manufactured and erected by the Dominion Bridge Company, of Lachine, Que. At the head of this lock there is another swing to pass the main road between Coteau Landing and Cascades Point. A similar structure will be erected at lock 3 in connection with the Quinze Chiens Road. The superstructure of these two small bridges is from the shops of the Weddell Company, at Trenton, Ont.

The remaining five road bridges cross the full prism of the canal, and have been designed to permit a full and free flow for the water and so as not to impede rapid navigation. This is effected by building the pivot pier in a line with the toe of the south slope, between which and the foot of the north slope there is an opening of 100 feet. The bridges are 246 feet long, and the south half swings partly over the land and partly over a channel formed in rear of the pivot pier to give additional water section. It is believed that this is a considerable improvement on the old method of placing the pivot in the middle of the canal with a narrow channel on each side of it where vessels have to slow up, and often find it difficult to get safely past. The piers, abutments, etc., of these bridges are of concrete coped with cut stone. The superstructure was manufactured and erected by the Dominion Bridge Company in a quite satisfactory manner.

To pass the drainage of the country, lying to the north, across the line of the canal, has necessitated a very large outlay. The first stream met with in descending is the River Delisle. This has its

sources some 60 miles inland. Its catchment basin has an area of about 180 square miles, and during spring floods the flow is sometimes over 200,000 cubic feet per minute. The river is passed under the canal through four lines of cast iron tubes 10 feet in diameter laid in a trench fifty feet wide, excavated in the rock to the depth required. The tops of these tubes are two feet below canal bottom. At each end there are masonry wells, and at the north end the macadam road is carried over by arches of masonry and concrete. This structure has been found to answer the required purposes satisfactorily. At no time has there been, so far, a greater head than from 18 inches to 2 feet on it, whilst the position is such that no just claims for backwater can arise. In connection with this culvert there has been excavated a channel of diversion of considerable length and dimensions, which secured a good foundation for the structure and diminished the interruption from water which would have been inevitable had it been placed in the old bed of the river. It is believed that this plan should be followed where at all practicable.

The next stream is called the Rouge River. Its flow during floods is about half that of the Delisle, and it is carried under the canal by two lines of tubes of the same diameter as those previously mentioned. The excavation for the foundation of this structure was carried down to boulder clay through a stratum of soft blue material, which gave a good deal of trouble through sliding during the progress of the work. A diversion channel has been formed here also, the sides of which are pitched with masonry laid in cement.

At the River à la Graisse the water is carried by a single line of tubes 10 feet in diameter. The foundations of this structure are on piles driven some 25 or 30 feet to hard material.

There are also two pipe culverts of small dimensions towards the lower end of the canal which do not merit particular description.

Now as to the dimensions of the canal itself.

Ordinary prism is throughout about 100 feet wide at bottom with side slopes of 2 to 1. The banks or cuts are first formed to these and then a notch is cut to receive the stone protection lining. This reaches from four feet below to four feet above mean level in the summit. It is about 3 feet wide at the base, tapering up to about one foot on top, where it is finished by a rough coping. Between this coping (158 0) and the top of the bank (161.0) the surface of the slope is sodded, the

sodding being returned about five feet on the level. On the north side of the canal a macadam road, 15 feet in width, will be formed throughout its entire length, the centre of which is 33 feet from the edge of the cut or bank on that side. This road was designed, not only for the service of the canal, but also to provide a means of intercommunication between the various farms cut across by the canal and the side roads where bridges are built, and so, if possible, reduce damages—a result which has not, however, been realized, as the sums paid for right of way are very much greater than was anticipated. The total quantity of land taken is about 9J0 acres, ample width having been secured throughout.

Wherever practicable, material arising from the excavation has been used to widen out the embankments to give additional safety. The north side of the canal where in filling is fifty feet wide on top. On the south side it is generally thirty feet at least. The large amount of surplus material was spoiled either on land adjacent to the canal taken for that purpose, or wasted into the St. Lawrence river at several points.

The small profile will show the various kinds of soil traversed by the canal. At the Cascades' end the excavation is in rock of the Potsdam formation, which affords a solid foundation for locks Nos. 1, 2 and 3. The upper extension walls of the latter lock are, however, of piles and concrete. The reach between locks Nos. 3 and 4 is in clay upon which the piers and abutments of the St. Antoine Road bridge are founded.

At lock No. 4 solid material is from 30 to 35 feet below the floor line. The lock walls are therefore placed upon a foundation of piles and concrete. They are 36½ feet high, and, from careful levels taken before and after building, they have not perceptibly subsided. The structures immediately to the west of lock No. 4, namely the guard gates, sluice abutments, retaining walls, etc., are all founded on the clay, which affords a sufficiently solid bearing. The road bridges at St. Feréol and St. Dominique are also built upon similar material.

It will be observed that the surface of the blue clay along the summit reach gradually rises towards the west and culminates at the crossing of the St. Emmanuel Road, where it is almost level with top bank, being only covered with a thin layer of sandy soil. Wherever this clay was cut into by the prism, there was danger of slides roughly in proportion to the depth of the cutting. This danger was

greater on the north side, which intercepted the natural drainage towards the river, so that in time the slope became so saturated as to break loose and slip into the canal. In other words, by the excavation of a deep trench of such dimensions, a similar condition of things was set up as that existing along the bank of the St. Lawrence between Coteau and Cascades, where, from time immemorial, *déboulements* have occurred, causing in many places a wearing away, which in some cases is measured by hundreds of feet.

One of these slides took place on the 25th October, 1897; when, without any previous perceptible warning, the north bank of the canal, for over a quarter of a mile in length, slid into the prism, taking with it the abutment of the St. Emmanuel bridge, which was thrown bodily forward about fifty feet into the centre of the canal. This occurrence is considered to be of so much interest as to warrant its being made the subject of a separate paper. To discuss it in detail at present would take up too much time.

Slides have also occurred more or less for a mile or so to the west of the St. Emmanuel Road, but a plan of repairs has been adopted which will enable the north slope to be satisfactorily restored in time for the opening of navigation through the canal.

Towards the crossing of the River Delisle, the surface of the blue clay lowers rapidly. At the river itself rock of the "calciferous" is encountered, and this alternates with the clays and sands of the drift formation for some two miles to the west. At the upper entrance the guard lock and surrounding structures are all founded upon solid rocks.

There are about 6¾ million cubic yards of clay of all sorts, and 300,000 cubic yards of rock of various kinds in the excavations for the canal.

The level of the bottom of the summit reach at the foot of the guard lock is 137.00 above datum. Ordinary surface of Lake St. Francis may be taken at 155.50, at which time there will be 18½ feet of water in the canal, equal to a cross sectional area of 2534 square feet. Propellers of the type now being built on the upper lakes to navigate these canals will have a submerged midships section of say $42 \times 14 = 588$ square feet, or less than one-fourth of that of the water area at mean level. This will permit of a fairly high speed through the summit reach, which it will be observed forms 75 per cent. of the whole length of the canal. The bottom of this reach has an inclination of

0.10 per mile. Top bank is level and 161.0 above datum. The cross section of the canal has, as before stated, been kept as nearly as possible uniform throughout. This will avoid the creation of cross currents, and facilitate the rapid navigation of the canal.

The relation of the area of the vessel to that of the canal is a matter of much importance. Full depth under the keel is of great value, both for speed and safety. The whole question of the gain in time in relation to the cost of construction affords ample scope for further investigation. It does not appear as if a slight increase in speed where the canals are short in comparison with the length of natural navigation would warrant a largely increased outlay even where ample means are at hand. As to locks, it is believed that, as has been stated, "The "single individual lock is better than the fleet lock, and can be operated "more quickly—and the maximum facilities may be provided by "duplicate locks. The lift of locks should be made as great as possible "where conditions permit, as time is consumed by the number of "locks rather than by the lift."

To return to a description of the locks. It was the writer's intention that these should be constructed entirely of concrete up to the level of the surface of the lower reach. In this particular the design was almost wholly frustrated, lock No. 4 only having been built on this plan. The nature of the foundations of all the locks having been previously indicated, it will perhaps be as well to describe the general features of lock No. 2, and thus avoid tedious repetition.

It will be observed that the lock is filled and emptied through culverts in the side walls, from which cast iron pipes 30 inches in diameter—ten on each side—lead into the bottom of the chamber. These pipes have about 40 per cent. greater discharging capacity than the culverts themselves. The lock will be filled in about five or six minutes, and this will be effected without subjecting the vessel to much surging or strain. At the head and foot of each culvert there is placed in a shaft (8′ x 4′) operated from the coping a 6′ x 6′ sluice of the "Stoney" pattern. These are for the first time introduced into a Canadian canal. Their operation is, as will be seen by the drawings, exceedingly simple. They are in extensive use in Europe, and have given the best satisfaction in controlling large bodies of water. They are used for that purpose on the Manchester ship canal. It may here be stated that the details for these gates

on the Soulanges Canal have been worked out and modified by Mr. Geo. H. Duggan, M. Can. Soc. C. E. This has been skilfully done; and it is believed that their operation throughout will prove quite satisfactory. The method of emptying and filling locks through tunnels in the side walls is considered to be entirely the best, and manifestly better than any system of filling from below the floor.

The main object in adopting this plan was, however, to avoid that in vogue on the Welland Canal, where the filling and emptying is done through valves in the gates. This is objectionable from every point of view. It weakens the gates just where most strength is required, and weighs them down with cumbrous valve gear. Besides, it introduces the water for filling so as to strike the stem of the vessel heavily, creating an unnecessary disturbance in the chamber and a tendency to surge it on the upper gates. All this is now well known to practical men, and need not be dilated upon here.

It will be observed that each lift lock is provided with a heavy breast wall at its upper end, corresponding in height to that of the lift. These walls have been re-introduced for the purpose of removing the cause of about nine-tenths of the accidents which have occurred on the enlarged canals; namely, vessels carrying away the upper gates of the locks by striking them whilst entering from the lower reach. It is difficult to understand why all the four gates of each lock on the Welland and other canals were made the same height—but there is no doubt that the plan is defective. If a vessel goes ahead too far in a Soulanges canal lift lock, she will strike against the breast wall, and damage herself instead of the gates.

The filling and emptying of the lock having, it is believed, been secured in a reasonable time in the way above described, it may now be stated that an attempt has been made to simplify the manner of working the gates by the use of struts operated in the manner shown in the accompanying drawings. An inspection of these will render further description unnecessary. It may, however, be noted here that the writer made a series of experiments in 1894 at Lock No. 9 of the Beauharnois Canal, which convinced him that this method would prove entirely practicable. Since then machinery of a similar kind, but on a greatly larger scale, has been and is now in operation on the North Sea Canal.

The gates are built on what is called the "solid" plan, which consists of a number of superimposed timbers shaped to the required hori-

zontal pattern and fastened together. The method is simple, and in this case the strength is superabundant. One leaf of the lower gates of the high lift locks at the Cascades' end of the canal weighs over 90 tons in the air. The drawings were made by Mr. J. B. Spence, M. Can. Soc. C. E., and the gates have been constructed in a thoroughly workmanlike manner by the firm of Messrs. J. & R. Miller, of Ingersoll, Ont., who have had very extensive experience in connection with the Welland and St. Lawrence canals. The timber used is principally Douglas fir, which was hauled across the continent for that purpose. A number of spare gates are also on hand in case of accident.

It is proposed to work a lock from one point on the south side and about 20 feet back from the coping, where a switch cabin will be placed as shown. This will be connected with the motors actuating the sluices and operating bars previously described. Suppose a vessel to enter the lock from the lower level. When her stem is up to the breast wall she signals, and the lower gates are closed. The machinery will effect this in a perfect manner. The gates will shut precisely and synchronously, and avoid any trouble from over lapping, which often occurs now. This should be done in one minute. The lower sluices are then dropped and the upper ones hoisted, the lock being filled as indicated. When the water has risen to the full height, the upper gates are opened and the vessel passes out. The lockages should be easily made in from 12 to 15 minutes. But the saving of time at a lock, although of much importance, has been unduly magnified. The capacity of the canal at four lockages per hour on the basis of one-third westbound freight would be about 20 millions of tons in an ordinary season. Of course, this estimate is merely theoretical. But even, if one-half of it is realized, it will require a good many ports like Montreal to handle such tonnage economically.

In the construction of the Welland Canal locks, nearly every mitre sill on the line was forced up, causing great delay to navigation, annoyance, and much expense. The plan of mitre sill and bottom designed for the Soulanges Canal will, it is believed, fully obviate these difficulties. It will not be possible under any imaginable circumstances to disarrange sills held down as shown on the plan of lock No. 2; which is a type of all the rest. It will also be seen that the mitre sills

themselves are the only pieces of timber in or connected with the lock bottom, and these can easily be renewed when this becomes necessary.

The extension walls above and below the locks and in immediate connection with their masonry should not be built on a twisting batter. Where these walls cease to be self-sustaining and become slope walls, they are sure to crack—and besides the bases of those at the lower ends of the locks are liable to be washed out by the strong currents created when they are emptied; and have a tendency to slide into the canal. All the walls connected with the upper and lower entrances to the locks of the Soulanges Canal stand upon their own bottoms, and are therefore not liable to failure in the way alluded to.

The macadam road which runs along the north side of the canal is carried past the locks by a series of ramps, the inclination of which does not exceed 1 in 8. To enable foot passengers to surmount the rise between the different levels, a flight of steps is provided on each side of the lower ends of all the locks.

Concrete has been introduced into the construction of these locks to an extent greater than heretofore in Canada. Since the plans for them were made, the use of this material has rapidly spread. But a few years ago experienced hydraulic engineers looked upon concrete construction with suspicion, at least in this climate. This is not to be wondered at, because the cement supplied (which is the life of concrete) was of very inferior quality and manufacture. Now, however, excellent Portland is obtained at moderate rates. On the Soulanges Canal the writer specified that cement of a certain quality should be supplied by the Government to the several contractors—and should not be purchased by them at all. The benefits of such a course are obvious. There is no inducement to supply an inferior article or to stint its use; both of which may happen with the ordinary type of canal contractor. It is better to remove the temptation than to depend upon the virtue of the individual. The specifications for the preparation of concrete do not offer any feature out of the common. Some 70,000 briquettes have been made for testing purposes in a quantity of about 200,000 barrels. Good clean sand and properly broken stone have been insisted upon; and so it is believed that this work is excellent throughout. Mixing has been done both by hand and machine, but in either case the product when carefully laid and rammed makes an unexceptionable hydraulic wall, whilst its cost per cubic yard is here less than half that of

masonry. Of course this varies with circumstances, but on the Soulanges Canal its use is clearly suggested by the fact that in the excavation for the prism about 300,000 cubic yards of rock had to be taken out, which is excellent for concrete, but unfit for masonry. This supplied the 150,000 cubic yards required for concrete—also about 120,000 cubic yards for stone protection, lining together with over 50,000 cubic yards for macadam, repairs etc.,—leaving a large surplus to be thrown to spoil.

It will be seen on reference to the plan of road bridges that these structures are almost entirely of concrete, the copings only being of cut stone. This remark will also apply to the retaining walls, regulating weirs, etc. A large amount of concrete was also used in connection with the culverts under the canal and in other positions too numerous to mention.

Time will not permit of more than a passing reference to the style of supply weir or regulating culverts designed for the canal. The plans will show details of construction. They can be made to control the levels automatically if so required. It will be seen that the weir at Lock No. 4 is connected with its south wall, and differs in construction from those at the lower locks.

It is believed that the drawings and photographs will show with sufficient clearness the main features of the culverts under the canal to pass the Rivers Delisle, Rouge and à la Graisse. The casting of the ten foot tubes was done by Messrs. H. Ives & Co., Montreal.

The site chosen for a power house to generate electricity for the operating of the locks, bridges, etc., and the lighting of the canal throughout has many advantages, and will perhaps merit a brief description, which must close this paper. At this place the River à la Graisse crosses under the canal, and joins the St. Lawrence about 400 feet to the south of it. The surface of the canal is as before stated at ordinary stage about 155.50 above datum. At such time the à la Graisse is about 135.00, or 20.5 feet lower. It is obvious that by drawing a sufficient volume from the summit reach and passing it through wheels, power can be readily obtained here; and from this site a free discharge can be had into a wide tail race connecting directly with the St. Lawrence on Government property where no claims for

damages can arise. Of course the above height of 20.5 feet represents the fall on the River St. Lawrence between Lake St. Francis and the mouth of the à la Graisse.

The amount of electrical power required to operate the locks, bridges and other structures and to light the canal satisfactorily throughout its entire length of fourteen miles was carefully determined by the officers of the Royal Electric Company, who also worked out the details of the distribution and application of this power. They also provided designs and drawings for the power house proper, and the switch cabins at the various locks, together with the necessary specifications. The hydraulic development was entrusted to Mr. A. M. Rice, of Dayton, O., a gentleman of acknowledged skill and experience in such matters. He prepared plans showing the number and position of the wheels, tail races, etc. These have been partly carried out; and work will be resumed in the spring. The power house is connected with a regulating weir previously referred to, and which is intended to control the summit level of the canal without discharging a great volume of water through the Cascades Locks. The works for electrical power plant have been recently let, and the whole system will be in operation next season. The canal will be efficiently lighted throughout, and, considering its position in the St. Lawrence system, this will be of great importance in securing safe navigation through it by night.

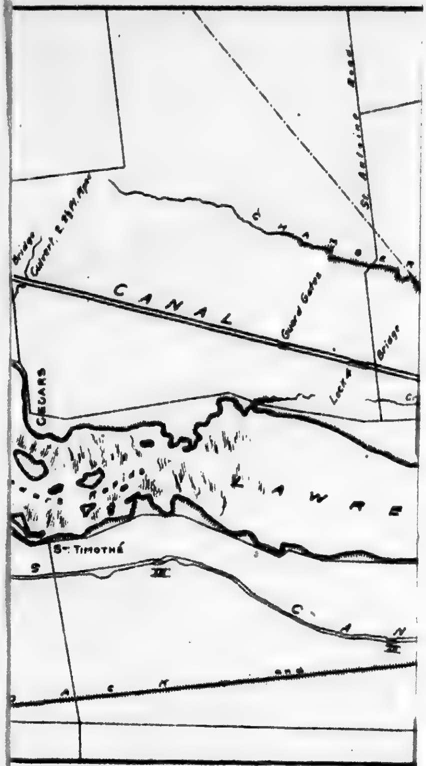
The entrances at each end of the canal are wide, of full depth, and sufficiently commodious. It will be observed that there are concrete walls heavily coped with cut stone on the top of the cribs, forming a permanent face work, instead of the timber generally used in such positions.

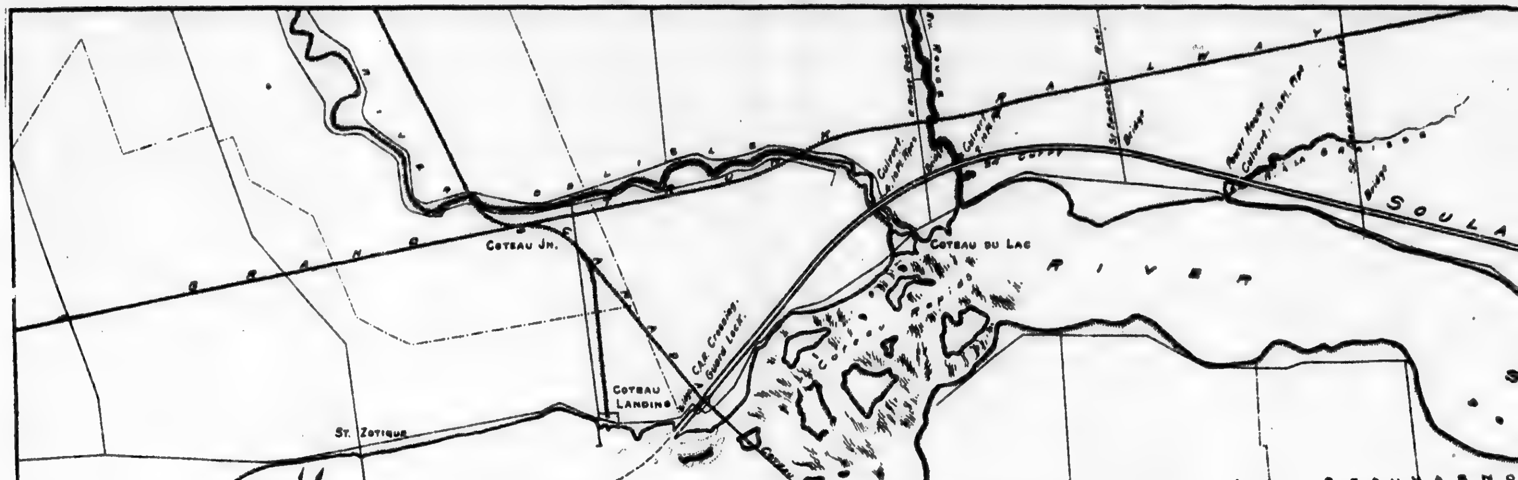
There are a number of other matters of interest to canal engineers which cannot even be touched upon in this sketch. It will, however, be seen that an attempt has been made to provide an unobstructed channel of full dimensions for a fourteen foot navigation at lowest water, with a much less number of locks than has hitherto been deemed advisable to overcome a similar fall on the other canals of the St. Lawrence system. In construction, materials of a practically imperishable kind have been almost wholly used, and this fact, taken in conjunction with the improved methods of operating the locks and bridges, will, it is believed, largely decrease the annual expenditure for maintenance and operation.

The writer sincerely hopes that the beneficial results which must follow the completion of the St. Lawrence Canals to dimensions capable of passing vessels of 2,000 tons will be realized to the fullest extent; and that the immense expenditure so pluckily incurred by Canada with her comparatively small population and limited resources may at last draw to our national route the current of European trade for which we have waited so long.

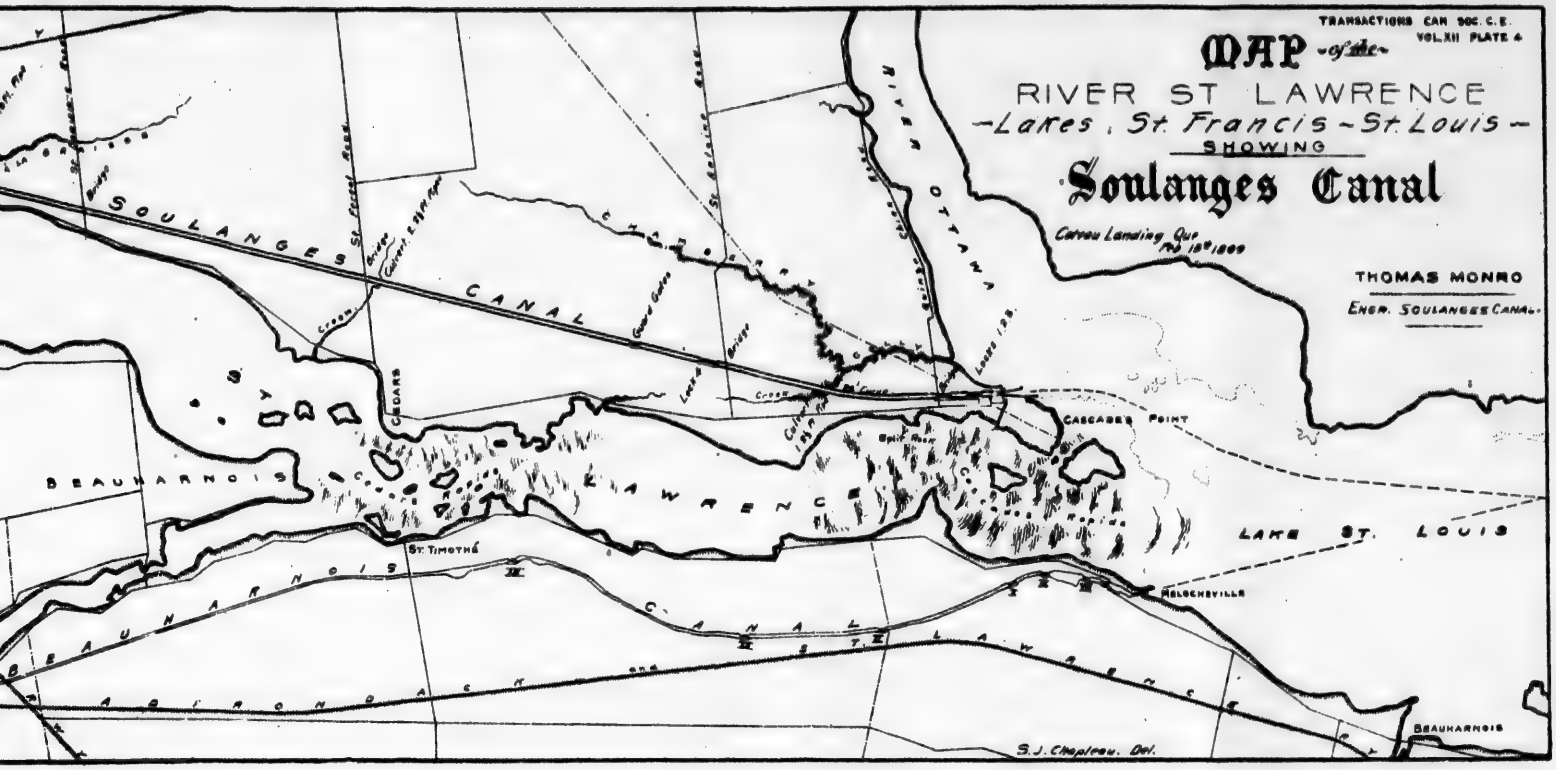
The writer may be permitted to state, in conclusion, that in his humble opinion, if such a large volume of traffic as may be reasonably expected on the completion of the St. Lawrence Canals has to be economically and quickly handled at Montreal, a very different condition of things to that existing there must at once be established and maintained. If not, the expected benefits to Canada will be largely neutralized or the point of trans-shipment for grain in bulk and whole cargoes will be transferred to Quebec.

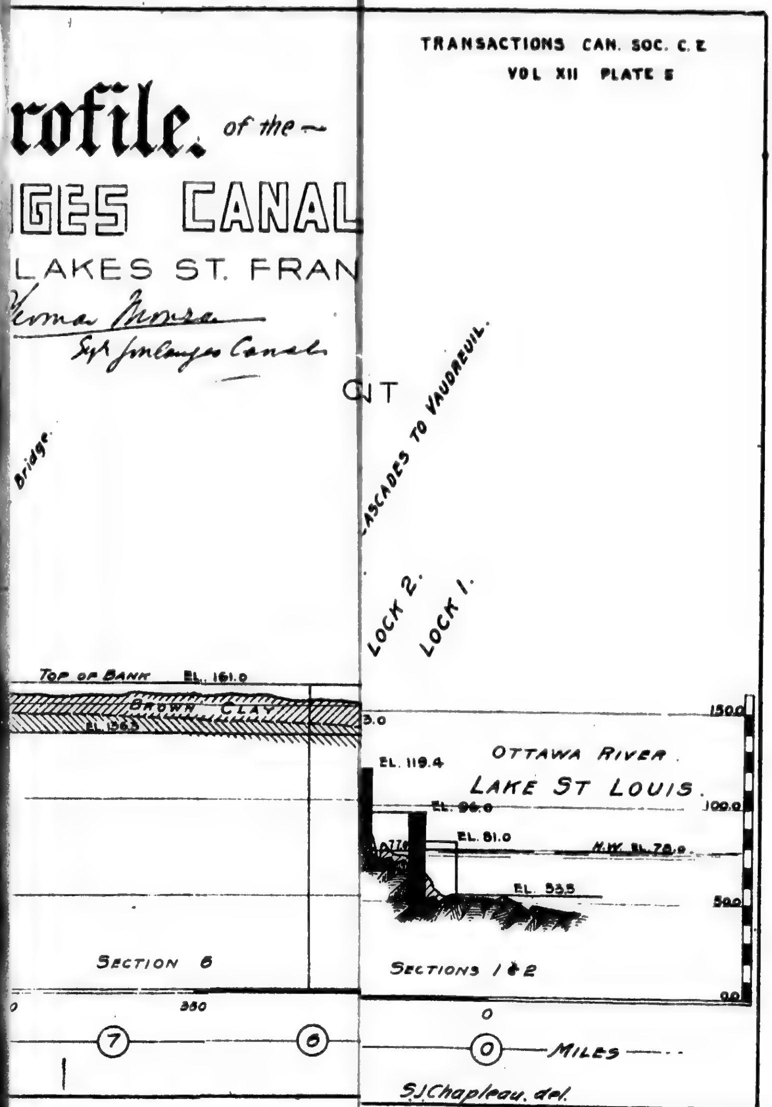
The thanks of the writer are due to Mr. John L. Allison, M. Can. Soc. C. E., by whom he was materially aided in the preparation of the general designs for the Canal and its structures. He also desires to acknowledge the zeal and intelligence of Messrs. C. R. Coutlée and A. J. Grant, A. M. Can. Soc. C. E., to whom together with a staff of juniors, inspectors, etc., the superintendence of the principal works has been entrusted.

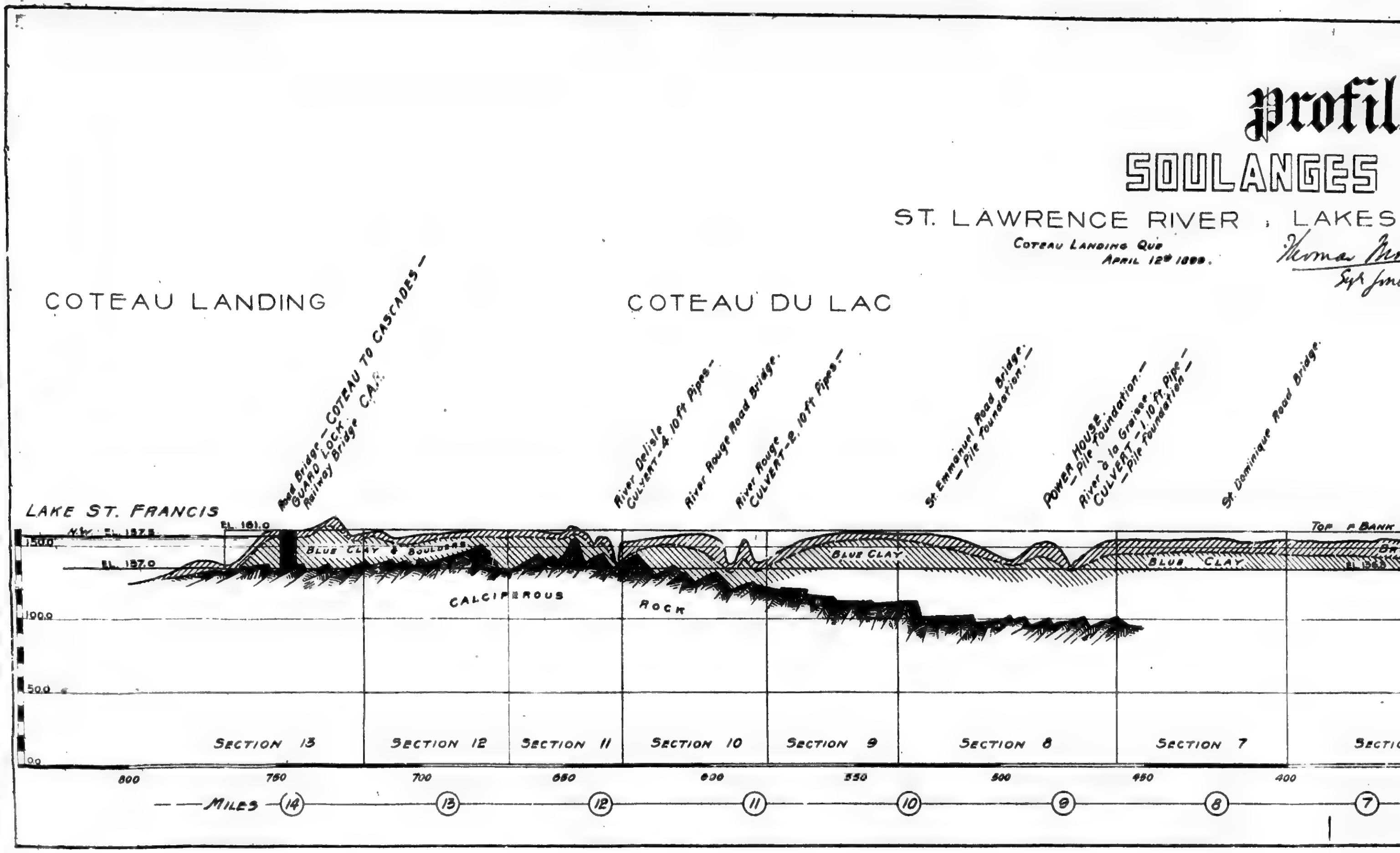

St. Antoine Road
Bridge
CANAL
Guard Gates
Bridge
Lock
CEDARS
St. TIMOTHÉ



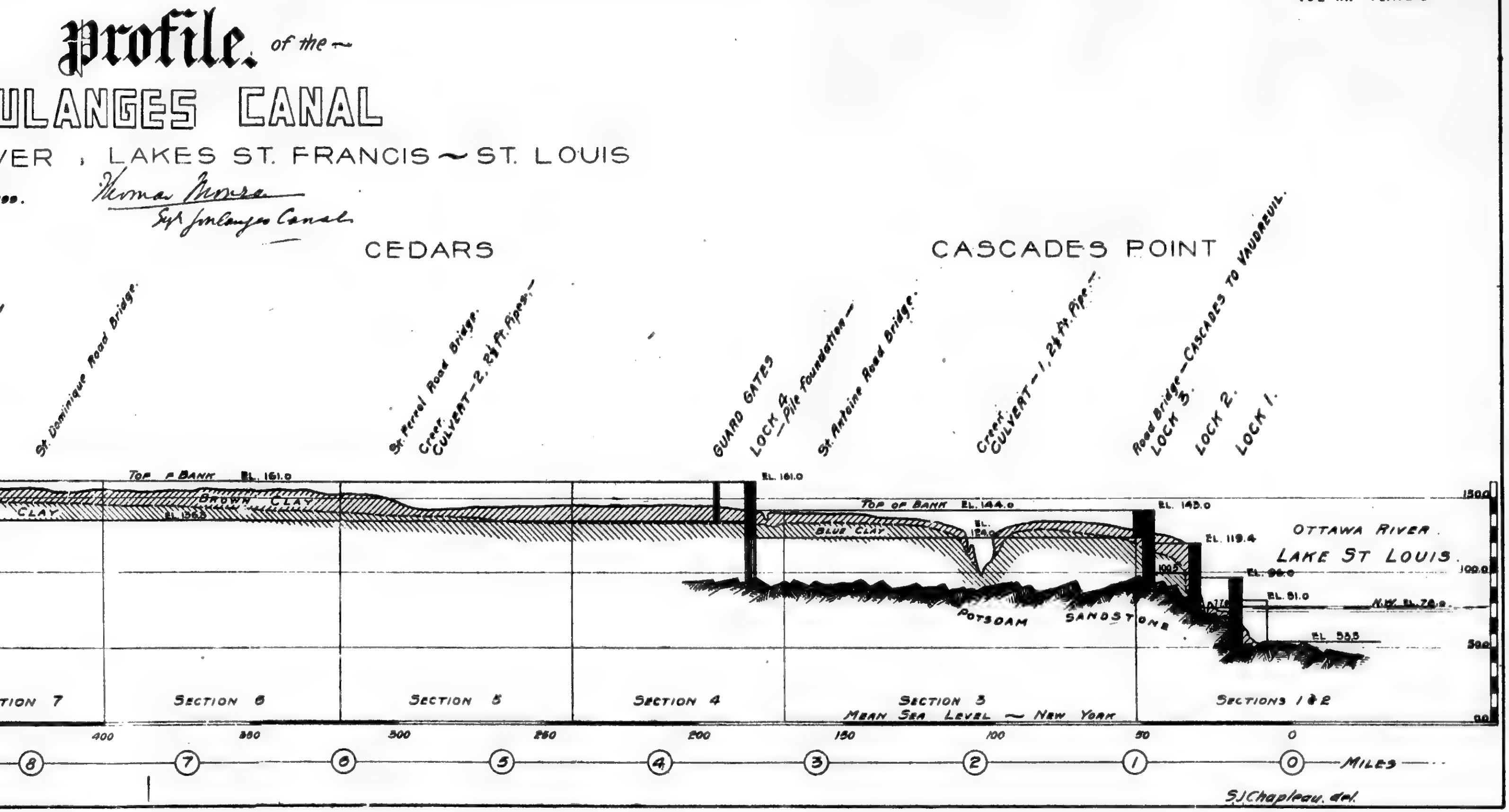
Coteau Jn.
Coteau du Lac
River
Soulanges
Coteau Landing
C.P.R. Crossing Guard Lock.
St. Zotique
Grand Ile de Beauharnois
Atlantic
Lake St Francis
Valleyfield
Hungry Bay.
Scale of Miles.
0 1/4 1/2 3/4 1 2 3


TRANSACTIONS CAN. SOC. C.E.
VOL. XII PLATE 4
MAP of the
RIVER ST LAWRENCE
-Lakes, St Francis - St Louis-
SHOWING
Soulanges Canal
THOMAS MONRO
ENGR. SOULANGES CANAL
SOULANGES
CANAL
RIVER
OTTAWA
CEDARS
LAWRENCE
BEAUHARNOIS
CASCADES POINT
LAKE ST. LOUIS
ST. TIMOTHÉ
MELOCHEVILLE
BEAUHARNOIS
CANAL
BEAUHARNOIS
S.J. Chapleau. Del.

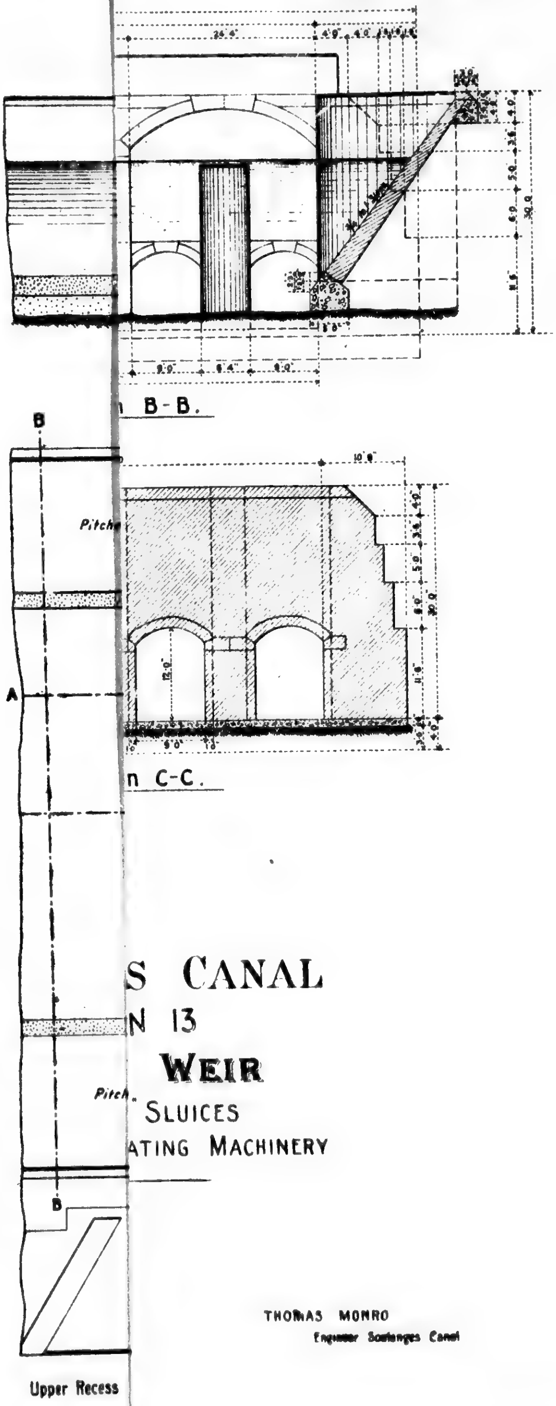

TRANSACTIONS CAN. SOC. C.E.
VOL XII PLATE 5
rofile. of the
IGES CANAL
LAKES ST. FRAN
Bridge.
CASCADES TO VAUDREUIL.
LOCK 2.
LOCK 1.
TOP OF BANK EL. 161.0
BROWN CLAY
EL. 119.4
OTTAWA RIVER.
LAKE ST LOUIS.
EL. 96.0
EL. 81.0
EL. 53.5
150.0
100.0
50.0
0.0
SECTION 6
SECTIONS 1 & 2
380
0
7
6
0
MILES
S.J.Chapleau, del.

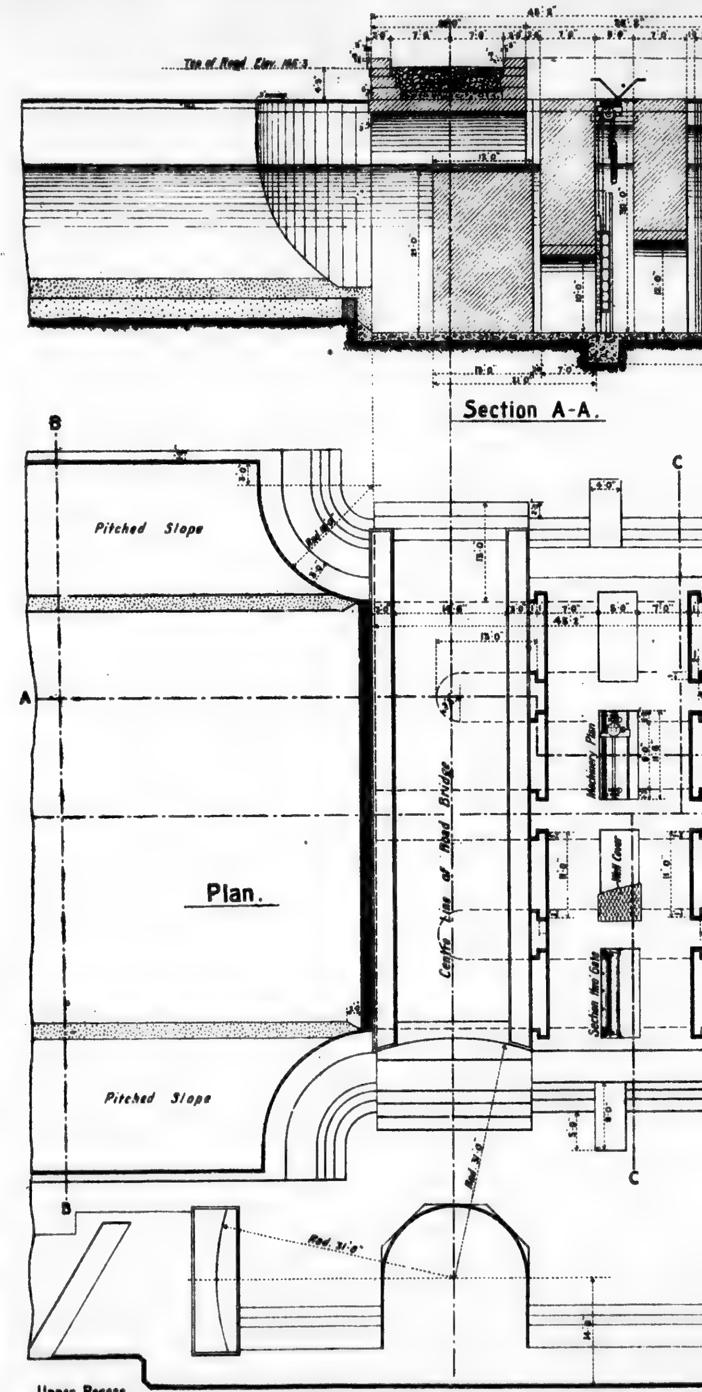

Profile
SOULANGES
ST. LAWRENCE RIVER , LAKES
Coteau Landing Que
April 12th 1899.
COTEAU LANDING
COTEAU DU LAC
Road Bridge — COTEAU TO CASCADES —
GUARD LOCK
Railway Bridge C.A.R.
River Delisle CULVERT — 4, 10 ft Pipes —
River Rouge Road Bridge.
River Rouge CULVERT — 2, 10 ft Pipes —
St. Emmanuel Road Bridge. — Pile Foundation. —
POWER HOUSE. — Pile Foundation. —
River à la Graisse CULVERT — 1, 10 ft. Pipe — — Pile Foundation —
St. Dominique Road Bridge.
LAKE ST. FRANCIS
H.W. EL. 157.5
EL. 161.0
EL. 157.0
TOP OF BANK
BLUE CLAY & BOULDERS
BLUE CLAY
BLUE CLAY
CALCIFEROUS ROCK
150.0
100.0
50.0
0.0
SECTION 13
SECTION 12
SECTION 11
SECTION 10
SECTION 9
SECTION 8
SECTION 7
SECTIO
800
750
700
650
600
550
500
450
400
MILES
14
13
12
11
10
9
8
7

TRANSACTIONS CAN. SOC. C.E.
VOL XII PLATE 5

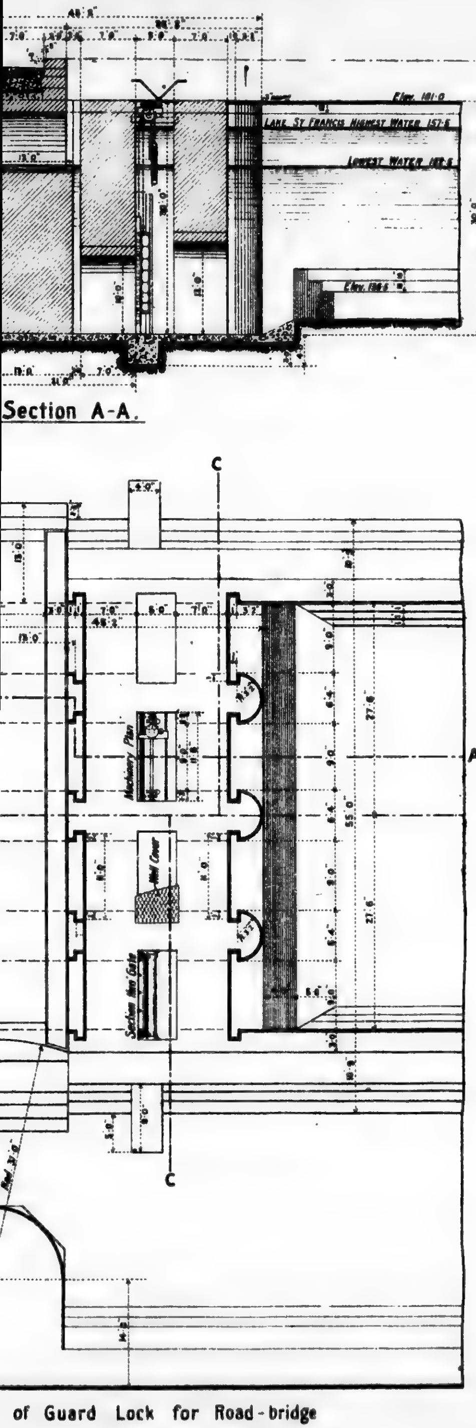


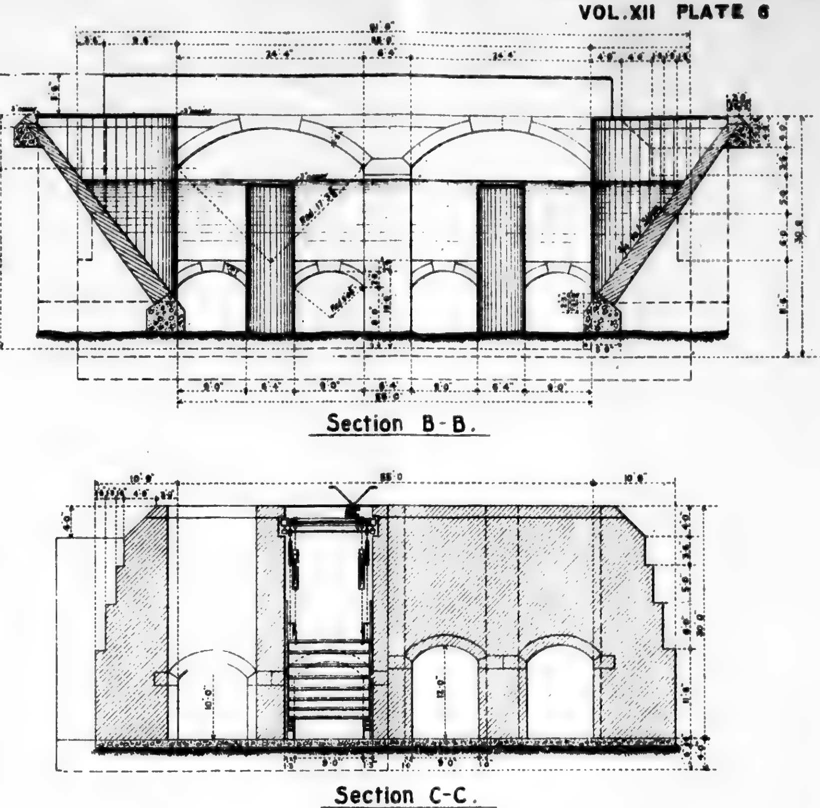
TRANSACTIONS CAN. SOC. C. E.
VOL. XII PLATE 6





Extension Wall of Guard Lock for Ro





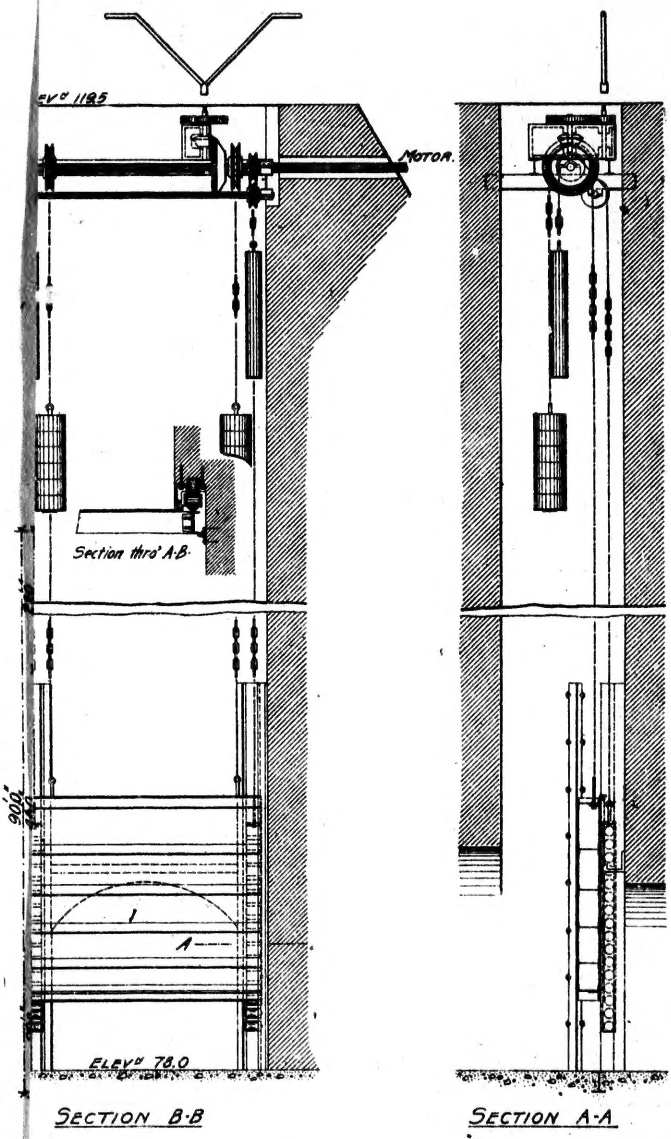
SOULANGES CANAL

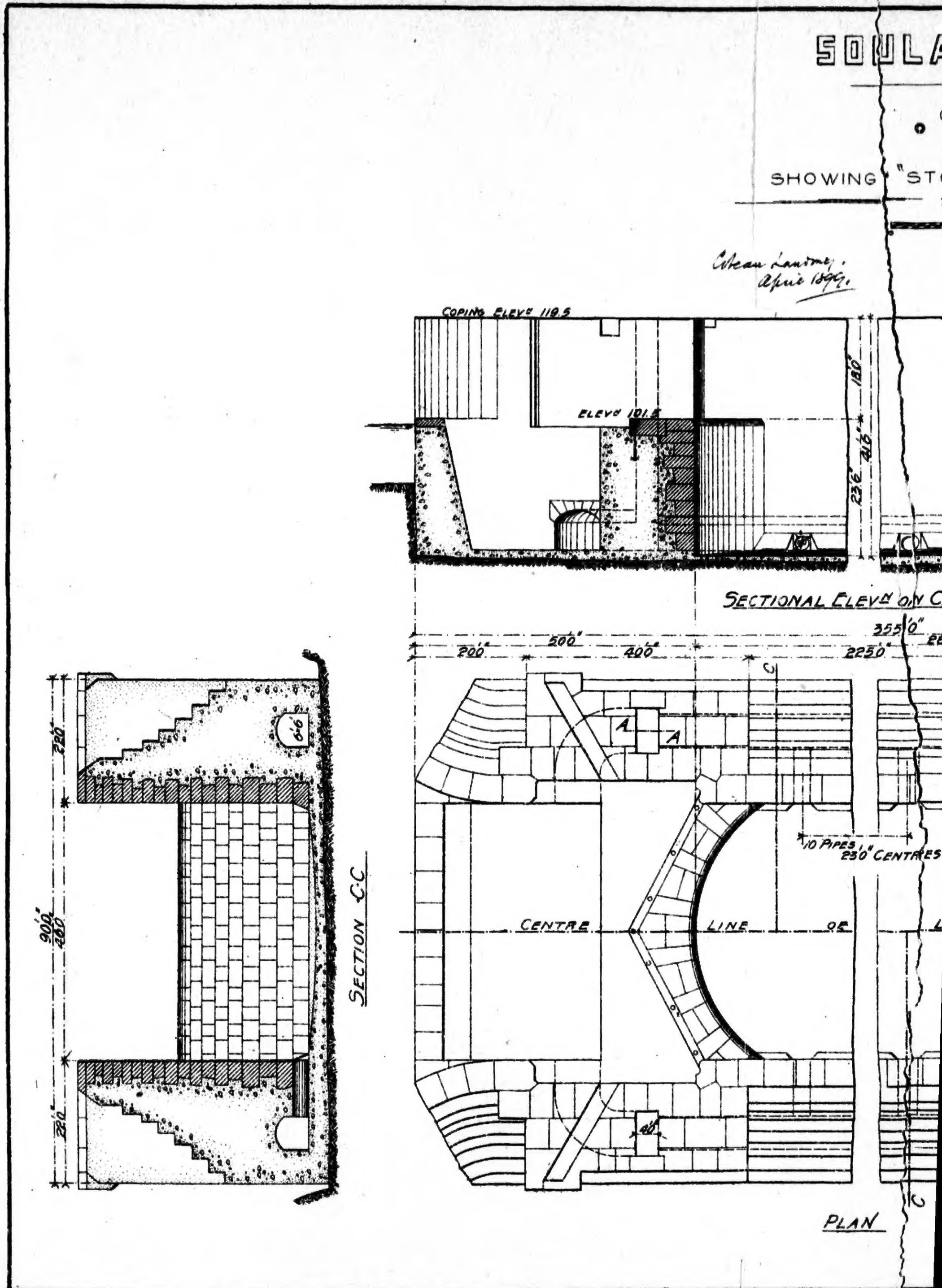
SECTION 13

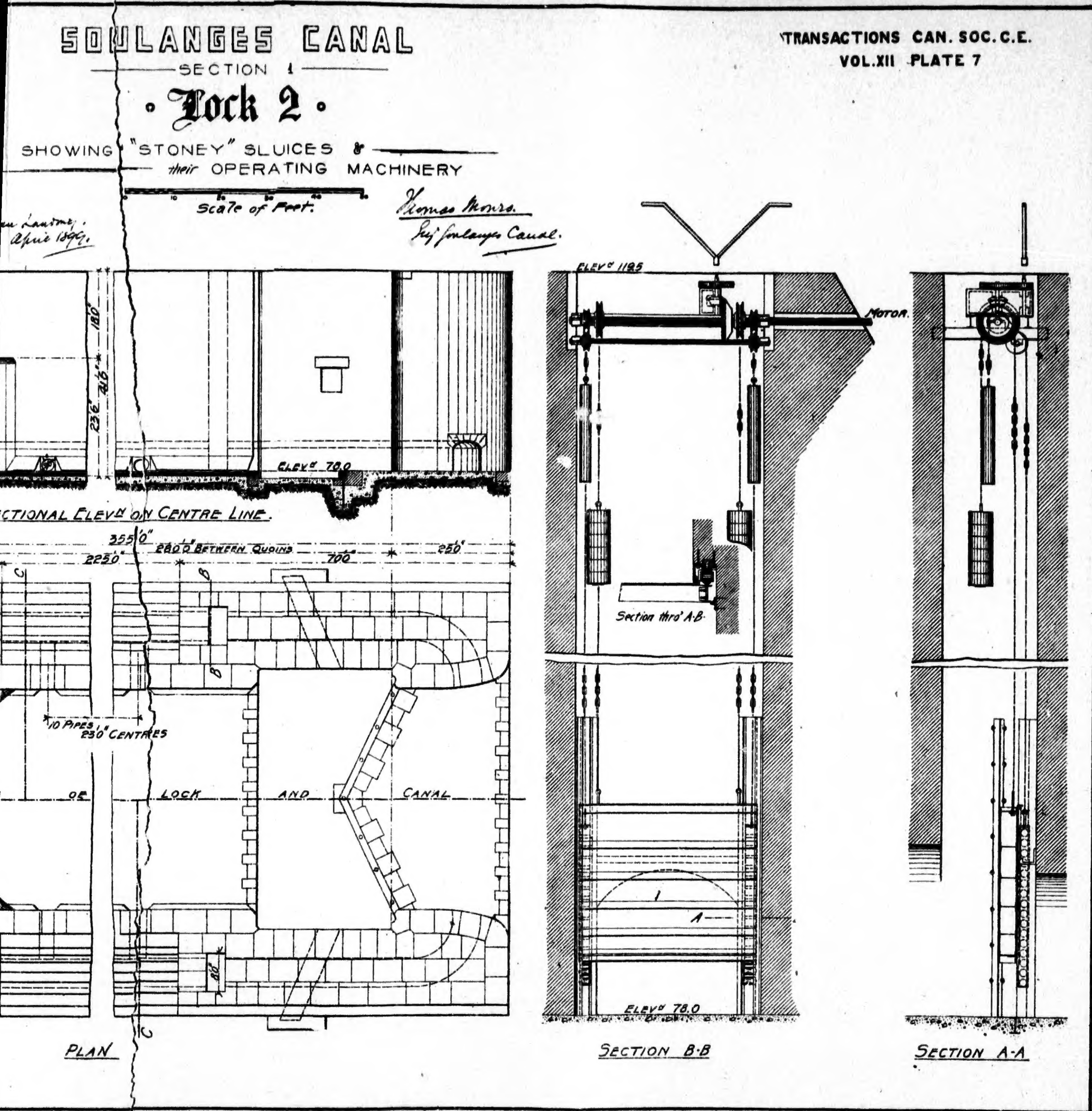
SUPPLY WEIR

SHOWING "STONEY" SLUICES
AND OPERATING MACHINERY

THOMAS MONRO
Engineer Soulanges Canal


ELEVᴰ 119.5
MOTOR.
Section thro' A-B.
ELEVᴰ 78.0
SECTION B-B
SECTION A-A


SOULA
SHOWING "STO
April 1899.
COPING ELEVN 119.5
ELEVN 101.5
SECTIONAL ELEVN ON CE
355'0"
20'0"
50'0"
40'0"
225'0"
10 PIPES, 23'0" CENTRES
CENTRE
LINE
OF
SECTION C.C
PLAN


SOULANGES CANAL
SECTION 1
Lock 2
SHOWING "STONEY" SLUICES & their OPERATING MACHINERY
Scale of Feet.
TRANSACTIONS CAN. SOC. C.E.
VOL. XII PLATE 7
ECTIONAL ELEVN ON CENTRE LINE.
ELEVN 78.0
355'0"
280'0" BETWEEN QUOINS
225'0"
70'0"
25'0"
10 PIPES, 23'0" CENTRES
LOCK
AND
CANAL
PLAN
ELEVN 119.5
MOTOR.
Section thro' A-B
ELEVN 78.0
SECTION B-B
SECTION A-A